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New Species of *Nototriton* (Caudata: Plethodontidae) from Eastern Guatemala

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CONTENTS

ABSTRACT	1
RESUMEN	2
INTRODUCTION	2
ACKNOWLEDGMENTS	2
MATERIAL AND METHODS	3
DESCRIPTIONS OF NEW SPECIES	3
DISCUSSION	8
LITERATURE CITED	8

ABSTRACT Three new species of *Nototriton* are described from eastern Guatemala. All of these diminutive species of salamanders occur in wet forest in the mountains (875–1150 m) near the Guatemala–Honduras border. Characteristics of size, proportion, and coloration distinguish these new species from each other and their congeners. Members of the genus *Nototriton* inhabiting Guatemala and Honduras may be placed in one of two distinctive morphotypes. One group appears to be adapted to a semifossorial existence and has small nares, a narrow head, short limbs, small hands and feet, and lacks a dark face mask; one of the new species belongs in this group. Members of the other group are adapted for climbing and have larger nares, broader heads, longer limbs, larger hands and feet, and a conspicuous dark face mask; two of the new species belong in this group.

Key words: Amphibia; Caudata; Plethodontidae; *Nototriton*; new species; Izabal; Zacapa; Guatemala.

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◁ Three new species of *Nototriton* are described for eastern

RESUMEN Tres nuevas especies de *Nototriton* son descritas del este de Guatemala. Estas especies de salamandras diminutas habitan bosques húmedos en las montañas (875–1150 m) cercanas a la frontera entre Guatemala y Honduras. Estas especies se distinguen entre sí y de otros miembros cercanos en base a características de tamaño, proporción y coloración. Los miembros guatemaltecos y hondureños del género *Nototriton* pueden ser asignados a uno de dos tipos morfológicos. Un tipo con miembros que parecen estar adaptados a la vida semifosorial, poseen pequeños orificios nasales, cabeza angosta, pequeñas manos y pies, extremidades cortas y carecen de un antifaz oscuro; una de las nuevas especies pertenece a este tipo. Los miembros del otro tipo se encuentran adaptados a trepar, poseen grandes orificios nasales, cabezas anchas, extremidades largas, manos y pies grandes y un antifaz; dos de las nuevas especies pertenecen a este tipo.

Palabras claves: Amphibia; Caudata; Plethodontidae; *Nototriton*; nuevas especies; Izabal; Zacapa; Guatemala.

INTRODUCTION

The number of new amphibian species described from Middle America during the last decade suggests that the herpetofauna of this region remains poorly known, even as the last vestiges of some forests are disappearing. Many species of diminutive Neotropical salamanders have escaped detection or have received scant systematic attention until fairly recently. One such example is the genus *Nototriton* which is widespread in Middle America, and occurs from Oaxaca, Mexico, to Costa Rica, where they inhabit wet forests at elevations usually of about 1000 m and above. Overall, the distribution of any particular species is restricted, although more than a single species of *Nototriton* may occur at a given locality. Previously, several obvious hiatuses were apparent in the known distribution of the genus, most notably in the highlands of northwestern Guatemala and those flanking the lower Motagua Valley. Herein we describe three species of *Nototriton* from the latter region.

Genera of Neotropical plethodontid salamanders have continued to undergo dramatic systematic revisions ever since Taylor (1944) provided some taxonomic stability by sorting the Mexican species into seven genera. Taylor's (1944) genus *Chiropterotriton*, in particular, was recognized, primarily on the basis of osteology, as being a somewhat heterogeneous group of species forming two rather distinctive groups in the uplands on either side of the Isthmus of Tehuantepec (Rabb, 1958). Further investigations by Rabb (1960) revealed that the group to the east of the isthmus was divisible into two distinct groups, one inhabiting western Guatemala and eastern Chiapas, and the other extending from Honduras to Costa Rica. The group inhabiting Chiapas and Guatemala was designated the *Chiropterotriton bromeliacia* group by Lynch and Wake (1975). Additional divisions were recognized by Wake and Lynch (1976), who recognized the *Chiropterotriton* alpha group for those species north of the Isthmus of Tehuantepec and the *Chiropterotriton* beta group for those species to the east of the isthmus; these authors suggested that each of these groups probably merited generic status. In the de-

scription of *C. veraepacis*, Lynch and Wake (1978) placed this species in what they designated the *C. nasalis* group, which was the equivalent of the *C. picadoi* group of Wake and Lynch (1976), and noted that on the basis of osteology this group could be partitioned into three parts: a northern group of three species in Guatemala and Honduras and two Costa Rican parts, each containing a single species.

The various groups of *Chiropterotriton* were reviewed by Wake and Elias (1983) who proposed two new genera: *Dendrotriton* for the *bromeliacia* group of *Chiropterotriton* beta and *Nototriton* for what previously was known as the *picadoi* group (Wake and Lynch, 1976) or *nasalis* group (Lynch and Wake, 1978). Subsequent to the description of the genus *Nototriton*, a redefined *nasalis* group came to be recognized (Papenfuss and Wake, 1987); it contained species from Chiapas (*N. alvarezdeltoroi*), Guatemala (*N. veraepacis*), and Honduras (*N. barbouri*, *N. nasalis*). More recently, several additional Honduran species have been described: *N. sanctibarbarus*, a population previously ascribed to *N. nasalis* and apparently closely related to that species (McCranie and Wilson, 1996), and *N. lignicola*, a species apparently closely related to *N. barbouri* (McCranie and Wilson, 1997).

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MATERIALS AND METHODS

Field work was conducted in one or more areas of the Sierra de Merendón and the Sierra de Espíritu Santo each year between 1993 and 1997. Specimens were preserved in formalin diluted to 10% of stock solution and transferred to a 70% ethanol solution within several weeks for permanent storage.

Some of the most important features differentiating species of *Nototriton* are certain morphological measurements which were made to the nearest 0.1 mm using an ocular micrometer. We use the following abbreviations: standard length from snout to posterior margin of vent (SL), tail length from posterior margin of vent to tip of tail (TL), head length from anterior end of snout to middle of gular fold (HL), head width at widest point (HW), head depth at posterior angle of jaw (HD), horizontal distance across external nares (NL), eyelid length (EL), eyelid width (EW), interocular distance between eyelids (IOD), distance from anterior edge of eye to end of snout (SN), distance between center of external nares (NN), forelimb length from insertion to tip of longest digit (FLL), hind limb length

from insertion to tip of longest toe (HLL), combined forelimb and hind limb lengths (CLL), forefoot width (FFW), hind limb width (HLW), depth of tail base (TD), and width of tail base (TW).

The color patterns of these tiny vertebrates were examined with a dissecting scope while they were submerged in alcohol. Color in life was taken from field notes and color slides in the University of Texas at Arlington collection. Drawings of the heads were made using a Zeiss SV8 stereomicroscope and associated drawing tube.

We have examined comparative material in the Natural History Museum at The University of Kansas (KU), Museum of Vertebrate Zoology (MVZ), the National Museum of Natural History (USNM), and the University of Texas at Arlington (UTA). Comparative data for certain species were taken from Dunn (1924), Schmidt (1936), Lynch and Wake (1978), Papenfuss and Wake (1987), Good and Wake (1993), and McCranie and Wilson (1996, 1997). For ease of comparison, we have followed the general format previously used by these authors to describe members of this genus.

DESCRIPTIONS OF NEW SPECIES

Some species of *Nototriton* are often relatively easily found by humans and are represented in museums by ample series. However, other species are notoriously difficult to collect and seem to be encountered more by accident than design. The species of *Nototriton* inhabiting the Sierra del Merendón in Guatemala are small; in our experience, they do not congregate in bromeliads or within rotting logs. Rather, two of these species appear to be terrestrial; most of the time they seem to live beneath thick strata of humus or leaf-litter, although they may venture into the open on wet nights. Another species was found in a bromeliad, but a search of several hundred of these plants during different times of the year yielded only this single individual. We have made many trips into the region during the last decade with the intent of augmenting the material at hand; these efforts have not met with success. Therefore, we decided the time has come to describe the following species.

Nototriton brodiei new species

Holotype.—The University of Texas at Arlington (UTA) A-50000, an adult female from the west slope of Cerro Pozo de Agua, Sierra de Caral, Municipio de Morales, Izabal, Guatemala, 1125 m elevation (15°22' N, 88°42' W), collected by Eric Smith (original field no. ENS 5323) on 10 July 1994.

Paratypes.—UTA A-50001, an adult female from the same locality as the holotype, but from 1140 m, collected 13 June 1994; and UTA A-51490 (Fig. 1), an adult female from Finca La Firmeza, Sierra de Caral, Municipio de Morales, Guatemala, 875 m elevation (15°22'33" N, 88°41'45" W), collected on 4 January 1996.

Diagnosis.—A member of the *Nototriton nasalis* group (sensu Papenfuss and Wake, 1987) that can be distinguished from *N. nasalis*, *N. veraepacis*, *N. sanctibarbarus*, *N. alvarezdeltoroi*, *N. adelos*, and two species subsequently described in this paper by having small nares (Fig. 2A) that are about 0.004 of the SL (vs. 0.015–0.029 in the other species) and by having relatively shorter limbs (CCL/SL = 0.31–0.33 vs. 0.40–0.54). Most notably, females differ further from female *N. nasalis* having limbs that are separated by 5.5 (vs. 2.5–3.5) costal folds; from female *N. veraepacis* in attaining a larger size (maximum of 34.5 mm vs. 32.5 mm), having a proportionally smaller head (0.12 vs. 0.13–0.15 of SL), more premaxillary plus maxillary teeth (60–62 vs. 45–57), and more vomerine teeth (23–24 vs. 8–11); from *N. sanctibarbarus* in having a relatively longer tail (1.42–1.44 vs. 0.82–1.14 of SL), a smaller head (0.12 vs. 0.13–0.16 of SL), a smaller hind foot (HFW/SL = 0.06 vs. 0.08–0.12),



Fig. 1. *Nototriton brodiei*, paratype (UTA A-51490), adult female, 32.0 mm SL. Reproduced from UTA slide no. 20537.

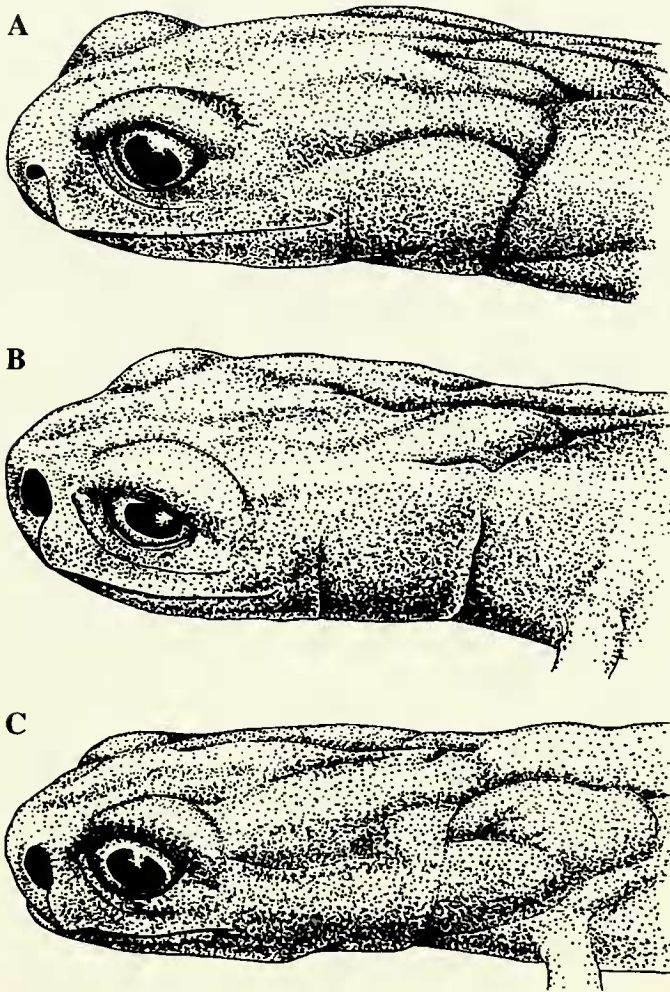


Fig. 2. Lateral aspect of heads of *Nototriton* from eastern Guatemala. (A) *Nototriton brodiei*, HL = 6.2 mm (UTA A-50000); (B) *N. wakei*, HL = 5.8 mm (UTA A-50002); and (C) *N. monzoni*, HL = 4.8 mm (UTA A-50003).

and adpressed limbs that are separated by 5.5 costal folds vs. 1; from *N. alvarezdeltoroi* in being larger (26.6 mm in male holotype of *N. alvarezdeltoroi*), in having a relatively longer tail (1.42–1.44 vs. 1.08–1.21 of SL), and in probably having more teeth (60–62 premaxillary plus maxillary teeth and 23–24 vomerine teeth in females vs. 52 and 9 teeth, respectively, in male). *Nototriton barbouri* and *N. lignicola* are similar to *N. brodiei* in having small feet, short limbs and comparatively small nares, but in *N. brodiei* the nares are proportionally smaller (0.004 vs. 0.005–0.016) and the relative tail length is longer (1.42–1.44 vs. < 1.16).

Description of holotype.—Snout broadly rounded in dorsal aspect and in profile; nares small; cirri weakly developed; eyes protuberant, but narrowly visible beyond margin of jaw when viewed from below; postorbital groove not reaching eyelid, extending posteriorly above vertical mandibular groove and intersecting with vertical gular

groove; head only slightly wider than neck; parotoid glands not strongly developed, bounded below by postorbital groove, posteriorly by gular groove, and above by a short horizontal groove that extends anteriorly only about length of gland; sublingual groove present; premaxillary plus maxillary teeth 60, extending to level about equal to center of eye; vomerine teeth 23, arranged in long arched series that extend to level well lateral to lateral edges of choanae; costal grooves 12; base of tail nearly round with no noticeable constriction; limbs short and slender, 5.5 costal folds between adpressed limbs; manus with four digits, tip of digit I rounded, tips of digits II–IV somewhat pointed, relative length of digits on manus I < IV < II < III; pes with five digits, tips of digits I, II, and V rounded, tips of digits III and IV somewhat pointed, relative length of digits on pes I < V < II < IV < III; hands and feet about one-half webbed; all digits with subdigital pads; postiliac glands scarcely developed; well developed cloacal folds present; the oviducts contain eight eggs (ca. 1.5 mm in diameter).

The following measurements and proportions are of the female holotype: SL 34.5 mm, TL 49.8 mm, TL/SL 1.44, HL 6.2 mm, HL/SL 0.18, HW 4.2 mm, HW/SL 0.12, HD 2.6 mm, NL 0.025, NL/SL 0.003, EL 2.1 mm, EW 1.1 mm, IOD 1.3 mm, SN 1.2 mm, NN 1.4 mm, FLL 5.0 mm, HLL 5.8 mm, CLL/SL 0.31, FFW 1.4 mm, HFW 2.0 mm, HFW/SL 0.06, TD 2.8 mm, and TW 2.7 mm.

In preservative, the dorsum of the trunk is tan with a herringbone pattern of 13 brown dorsal chevrons, pointed posteriorly, between the level of the axilla and groin. The dorsum of the head and neck are uniformly dark brown with the exception of the parotoid glands which are largely pale. No face mask is present; the sides of head and neck are similar in coloration to that of the dorsum. An irregular, faintly mottled cream band on the flanks extends between the axilla and groin. The venter of the chin, throat, trunk, and tail is brown with small cream spots; the limbs are similarly patterned with some larger cream spots on their undersurfaces.

Variation.—The female paratypes are similar in most respects to the holotype. There are 62 premaxillary plus maxillary teeth and 24 vomerine teeth in UTA A-50001. Measurements and proportions for the type-series, including the holotype, are as follows: SL 33.2–34.5 mm, TL 47.3–49.8 mm, TL/SL 1.42–1.44, HL 6.0–6.5 mm, HL/SL 0.18–0.19, HW 4.0–4.2 mm, HW/SL 0.12, HD 2.3–2.6 mm, NL 0.15, NL/SL 0.0043–0.0045, EL 2.0–2.2 mm, EW 1.0–1.1 mm, IOD 1.3 mm, SN 1.0–1.2 mm, NN 1.3–1.4 mm, FLL 5.0–5.1 mm, HLL 5.5–6.2 mm, CLL/SL 0.31–0.33, FFW 1.2–1.4 mm, HFW 1.5–2.0 mm, HFW/SL 0.04–0.06, TD 2.7–2.8 mm, and TW 2.6–2.7 mm. UTA A-50001 has 12 brown dorsal chevrons on the trunk (somewhat indistinct on anterior of body), the yellow spotting on the chin and throat is prominent, spotting on the trunk is irregular and more spots are present in the ventrolateral area, and the limbs have relatively large pale spots or blotches on both upper and lower surfaces, especially near their insertions.

Color in life.—Dorsal ground color mahogany (UTA A-50001) or rust-brown (UTA A-51490), dorsal chevrons dark brown, venter of trunk and tail blackish (UTA A-50001) or dark purplish brown (UTA A-51490) with cream flecks, tail ventrolaterally with irregular black or dark brown markings, iris bronze.

Etymology.—The species name is a noun in the genitive case, formed in honor of Edmund D. Brodie, Jr., in recognition of his significant contributions to the knowledge of salamander behavior and in appreciation of his help to us over many years.

Habits and habitat.—This species was found near the crest of Cerro Pozo de Agua which reaches an elevation of 1221 m and may be located on the Instituto Geográfico Militar 1:50,000 map of Guatemala (Hoja 2462II). Cerro Pozo de Agua is one of the higher peaks in the range known locally as the Sierra de Caral, which, in turn comprises part of the the Sierra del Merendón. This locality is located only about 3 km airline NW of the Honduran border on the slopes drained by the upper tributaries of the Río Bobos.

The type-locality of *Nototriton brodiei* is in subtropical wet forest (Holdridge, 1959), although daytime temperatures can be relatively warm. All specimens were taken from primary forest. The holotype, collected well after nightfall at 2115 h, was active on a broad green leaf about 10 cm above the forest floor when the air temperature had fallen to only 20° C. One of the paratypes was collected beneath a pile of dead palm leaves in a small clearing at 1620 h when the air temperature was 24° C, and the other was found crawling on a rock bank near a small waterfall at 0110 h when the air temperature was 19° C.

Other species of amphibians that we collected near the type-locality of *N. brodiei* were *Bolitoglossa dofleini*, *B. dunni*, *B. mexicana*, *B. rufescens*, *Agalychnis callidryas*, *A. moreletii*, *Duellmanohyla soralia*, *Hyla bromeliacia*, *Ptychohyla hypomycter*, *Smilisca baudinii*, *Hyalinobatrachium fleischmanni*, *Plectrohyla matudai*, *Bufo campbelli*, *B. marinus*, *B. valliceps*, several species of *Eleutherodactylus* and *Rana*, and the following species of salamander.

Nototriton wakei new species

Holotype.—The University of Texas at Arlington (UTA) A-50002 (Fig. 3), an adult female from the west slope of Cerro Pozo de Agua, Sierra de Caral, Municipio de Morales, Izabal, Guatemala, 1150 m elevation (15°22' N, 88°42' W), collected by Eric Smith (original field no. ENS 5060) on 11 June 1994.

Diagnosis.—A member of the *Nototriton nasalis* group (sensu Papenfuss and Wake, 1987) in which females may be distinguished from those of *N. brodiei*, *N. lignicola*, and *N. barbouri* by having large nares (Fig. 2B) that are about 0.022 of the SL (vs. 0.004–0.016 in those three species) and by having relatively longer limbs (CCL/SL = 0.44 vs. 0.30–0.34). The female holotype of *N. wakei* further differs from female *N. brodiei* in having a shorter tail (TL/SL = 1.18 vs. 1.42–1.44), wider head (HW/SL = 0.15 vs. 0.12), 2.5 (vs. 5.5



Fig. 3. *Nototriton wakei*, holotype (UTAA-50002), adult female, 26.8 mm SL. Reproduced from UTA slide no. 17903.

costal folds between adpressed limbs, 54 (vs. 60–62) premaxillary plus maxillary teeth, and 11 (vs. 23–24) vomerine teeth in short, straight rows forming an obliquely angled chevron and extending to about the level of the medial edge of the choanae; from *N. lignicola* in having a relatively longer tail (TL/SL = 1.18 vs. 0.84–1.01), a wider head (HW/SL = 0.15 vs. 0.10–0.12), fewer costal folds between adpressed limbs (2.5 vs. 5), fewer premaxillary plus maxillary teeth (54 vs. 58–62), and fewer vomerine teeth (11 vs. 16–24); and from *N. barbouri* in having a relatively longer tail (1.18 vs. 1.03–1.15) and fewer costal folds between adpressed limbs (2.5 vs. 4.5–6.5). *Nototriton wakei* is similar to *N. adelos*, *N. alvarezdeltoroi*, *N. nasalis*, *N. sancticrucis*, *N. veraepacis*, and a species described subsequently in this paper in having relatively long limbs (CLL/SL \geq 0.40) and in having large nares (NL/SL \geq 0.015). However, *N. wakei* differs from *N. nasalis* in having a distinctive vertical groove behind the mandible, shorter toes, larger nares (NL/SL = 0.022 vs. 0.016–0.021), a much darker ground color, and the dorsal spotting on base of tail reduced to a pair of small spots; from female *N. sanctibarbarus* in having a relatively longer tail (TL/SL = 1.18 vs. 0.82–1.14), a relatively shorter limb length (CLL/SL = 0.44 vs. 0.48–0.54), 2.5 (vs. 1) costal folds between adpressed limbs, and fewer vomerine teeth (11 vs. 12–18); and from *N. veraepacis* in having relatively shorter limbs (CLL/SL = 0.44 vs. 0.45–0.49) and larger nares (NL/SL = 0.022 vs. 0.015–0.019). *Nototriton wakei* may be distinguished from the species described later in this paper in having a longer tail (TL/SL = 1.18 vs. 1.04), relatively longer limbs (CLL/SL = 0.44 vs. 0.42), digits that have rounded rather than pointed tips, and hands and feet with little webbing. *Nototriton wakei* differs from *N. adelos* in having larger feet (HFW/SL = 0.09 vs. 0.06), larger nares (NL/SL = 0.022 vs. 0.016–0.019), and fewer costal folds between adpressed limbs (2.5 in female type vs. 4 in male type, respectively—female *N. adelos* can be predicted to have even more costal folds between adpressed limbs). *Nototriton alvarezdeltoroi* differs from *N. wakei* in having slightly larger nares (NL/SL = 0.024–0.026 vs. 0.022) and more costal folds between adpressed limbs (4 in male type). The type of *N. wakei* appears to be an adult with large ovarian eggs; at 26.8 SL this may be a rela-



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tively small species, comparable perhaps only to the two Mexican species of the genus.

Description of holotype.—Snout broadly rounded in dorsal aspect and in profile; nares large; cirri weakly developed; eyes protuberant, but scarcely visible beyond margin of jaw when viewed from below; postorbital groove absent, but a vertical groove just beyond the angle of the jaw extending from just below level of angle of jaw to level about equal to middle of eye; vertical gular groove extending across venter of neck; head only slightly wider than neck; parotoid glands not strongly developed and bordered posteriorly by gular groove and dorsally by a short horizontal groove; sublingual groove present; premaxillary plus maxillary teeth 54, vomerine teeth 11 in relatively short, straight series forming obliquely angled chevron, extending only to about level of medial margins of choanae; costal grooves 12, base of tail slightly laterally compressed but with no constriction; limbs relatively long, 2.5 costal folds between adpressed limbs; manus with four digits, tips of digits rounded, relative length of digits on manus I < IV < II < III; pes with five digits, tips of digits rounded, relative length of digits on pes I < V < II < IV < III; webbing on manus and pes slight; all digits with subdigital pads; postiliac glands not apparent; well developed cloacal folds present.

The following measurements and proportions are of the female holotype: SL 26.8 mm, TL 31.7 mm, TL/SL 1.18, HL 5.8 mm, HL/SL 0.22, HW 4.0 mm, HW/SL 0.15, HD 2.2 mm, NL 0.06, NL/SL 0.022, EL 1.6 mm, EW 1.0 mm, IOD 1.4 mm, SN 1.3 mm, NN 1.5 mm, FLL 5.8 mm, HLL 5.9 mm, CLL/SL 0.44, FFW 1.7 mm, HFW 2.3 mm, HFW/SL 0.09, TD 2.6 mm, and TW 2.3 mm.

In preservative, the dorsum is dark gray-brown with small, paler, coalesced and irregular blotches along the middorsum of the trunk. There are a few scattered pale spots on the dorsum. The interorbital region and top of the snout have some irregular pale markings, the eyelids are dark gray, and most of the parietal area and top of the neck are pale with numerous, scattered melanophores. A pale streak extends from the posterior edge of the eyelid across the parietal area onto the side of the neck. There is a dark gray, roundish, middorsal spot on the anterior part of the neck and a pair of dark gray, longitudinally elongate blotches on the posterior part of the neck. A face mask is present with the sides of the head and neck dark brown; a few small pale spots are present along the lips. A pair of pale spots is present on the dorsum of the base of the tail. The dorsal surfaces of the limbs are brown with pale spots or blotches; the undersurface of the limbs are mostly pale. The venter of the head and trunk is paler than the dorsum, being cream heavily suffused with brown with numerous pale flecks in the ventrolateral area between the limb insertions.

Color in life.—Dorsum rust-brown heavily suffused with black; streaks from posterior of eye through parietal area to insertion of forelimb, small dorsolateral spots on trunk, and large irregular blotches on dorsum of tail rust-



Fig. 4. *Nototriton monzoni*, holotype (UTA A-50003), subadult female, 22.3 mm SL. Reproduced from UTA slide no. 16531.

colored with little suffusion of black; ventrolateral region of trunk with irregular black blotches; iris bronze.

Etymology.—The species name is a noun in the genitive case, formed in honor of David B. Wake, in recognition of his significant contributions to the knowledge of neotropical salamander systematics and biogeography.

Habits and habitat.—A description of the type-locality and other ecological notes are given in the account of *N. brodiei*. The holotype of *N. wakei* was collected along the edge of a small trail running through primary forest at 2100 h when the air temperature was 22° C. It was resting on a palm frond about 70 cm above the forest floor. The type-locality is only about 3 km airline NW of the Honduran border on the slopes drained by the upper tributaries of the Río Bobos.

Nototriton monzoni new species

Holotype.—The University of Texas at Arlington (UTA) A-50003 (Fig. 4), an adult female from Cerro del Mono, near La Unión, Zacapa, Guatemala, 1570 m elevation (14° 58' N, 89° 17' W), collected by J. A. Campbell (original field no. JAC 18415) on 7 August 1993.

Diagnosis.—A member of the *Nototriton nasalis* group (sensu Papenfuss and Wake, 1987) in which females may be distinguished from those of *N. brodiei*, *N. lignicola*, and *N. barbouri* by having large nares (Fig. 2C) that are about 0.022 of the SL (vs. 0.003–0.016 in those three species) and relatively longer limbs (CCL/SL = 0.42 vs. 0.30–0.34). The female type of *N. monzoni* further differs from female *N. brodiei* in having a shorter tail (TL/SL = 1.04 vs. 1.42–1.44), wider head (HW/SL = 0.14 vs. 0.12) 2.5 (vs. 5.5) costal folds between adpressed limbs, 50 (vs. 60–62) premaxillary plus maxillary teeth, and 8 (vs. 23–24) vomerine teeth that are disposed in short, straight rows which form an acutely angled chevron and which do not extend to the level of the medial edge of the choanae; from *N. lignicola* in having a wider head (HW/SL = 0.14 vs. 0.10–0.12), fewer costal folds between adpressed limbs (2.5 vs. 5), fewer premaxil-

lary plus maxillary teeth (50 vs. 58–62), and fewer vomerine teeth (8 vs. 16–24); and from *N. barbouri* in having fewer costal folds between adpressed limbs (2.5 vs 4.5–6.5). *Nototriton monzoni* is similar to *N. adelos*, *N. alvarezdeltoroi*, *N. nasalis*, *N. sanctibarbarus*, *N. veraepacis*, and *N. wakei* in having relatively long limbs ($CLL/SL \geq 0.40$) and in having large nares ($NL/SL \geq 0.016$). However, *N. monzoni* differs from all large-nares species, except possibly *N. adelos*, in having smaller hands and feet ($HFV/SL = 0.07$ vs. 0.08–0.12), somewhat pointed digit tips, and moderately extensive webbing between the digits. *Nototriton monzoni* further differs from *N. nasalis* in having a relatively shorter tail ($TL/SL = 1.04$ vs. 1.11–1.40), shorter limbs ($CLL/SL = 0.42$ vs. 0.43–0.45), and larger nares ($NL/SL = 0.022$ vs. 0.016–0.021); from *N. sanctibarbarus* in having relatively shorter limbs ($CLL/SL = 0.42$ vs. 0.48–0.54), 2.5 (vs. 1) costal folds between adpressed limbs, and fewer vomerine teeth (8 vs. 12–18); and from *N. veraepacis* in having a relatively shorter tail ($TL/SL = 1.04$ vs. 1.17–1.30) and larger nares ($NL/SL = 0.022$ vs. 0.015–0.019). *Nototriton monzoni* may be distinguished from *N. wakei* in having a shorter tail ($TL/SL = 1.04$ vs. 1.18), relatively shorter limbs ($CLL/SL = 0.42$ vs. 0.44), and extensive webbing on the hands and feet. *Nototriton monzoni* differs from *N. adelos* in having larger nares ($NL/SL = 0.022$ vs. 0.016–0.019) and fewer costal folds between adpressed limbs (2.5 in female type vs. 4 in male type). *Nototriton alvarezdeltoroi* differs from *N. monzoni* in having slightly larger nares ($NL/SL = 0.024$ –0.026 vs. 0.022) and more costal folds between adpressed limbs (4 in male type). The type of *N. monzoni* appears to be a subadult and contains ovarian eggs that are just beginning to become enlarged.

Description of holotype.—Snout broadly rounded in dorsal aspect and in profile; nares large; cirri weakly developed; eyes protuberant, but narrowly visible beyond margin of jaw when viewed from below; postorbital groove poorly developed, reduced to little more than a shallow depression, and a poorly developed vertical groove located just beyond the angle of the jaw and extending from the ventrolateral surface of the head to a level about equal to middle of eye; vertical gular groove extending across venter of neck; head only slightly wider than neck; parotoid glands not strongly developed, bordered posteriorly by gular groove and dorsally by a short horizontal groove; sublingual groove present; premaxillary plus maxillary teeth 50, vomerine teeth in relatively short, straight series of 4 teeth per side, forming acutely angled chevron, not extending to level of medial margins of choanae; costal grooves 12, base of tail slightly laterally compressed but with no constriction; limbs relatively long, 2.5 costal folds between adpressed limbs; manus with four digits, tips of digits pointed, relative length of digits on manus $I < IV < II < III$; pes with five digits, tips of digits pointed, relative length of digits on pes $I < V < II < IV < III$; moderately extensive webbing present; all digits with subdigital pads; postiliac glands not apparent; well developed cloacal folds present.

The following measurements and proportions are of the female holotype: SL 22.3 mm, TL 23.1 mm, TL/SL 1.04, HL 4.8 mm, HL/SL 0.22, HW 3.2 mm, HW/SL 0.14, HD 2.0 mm, NL 0.05, NL/SL 0.022, EL 1.4 mm, EW 1.0 mm, IOD 1.0 mm, SN 0.9 mm, NN 1.2 mm, FLL 4.6 mm, HLL 4.8 mm, CLL/SL 0.42, FFW 1.0 mm, HFW 1.5 mm, HFW/SL 0.07, TD 1.9 mm, and TW 1.8 mm.

In preservative, the dorsum is dark brown with an irregular pale brown dorsal stripe on the trunk and the tail. The top of the head is mostly brown and the eyelids are dark gray. A pale streak extends from the posterior edge of the eyelid across the parietal area onto the side of the neck to almost the level of the forelimb insertion. There is a pair of longitudinally elongate blotches on the posterior part of the neck. A fairly distinctive black face mask is present; the side of the head and neck dark brown to almost black. A large, irregular spot is present on the dorsum at the base of the tail. The dorsal surfaces of the limbs are brown with pale spots or blotches; about half of the undersurface of the limbs is pale. The venter of the head and neck is darker than the dorsum, being dark brown with cream spots; the venter of the trunk is also darker than the overall ground color of the dorsum and has numerous small pale flecks in the ventrolateral region between limb insertions; a few small pale blotches are present around the vent.

Color in life.—Dorsal ground color brown; small bluish flecks on dorsum and sides of head and body, most numerous in ventrolateral region of trunk between limb insertions; parietal streaks, middorsum, and dorsum of tail rust-colored; iris copper-colored.

Etymology.—The species name is a noun in the genitive case, formed in honor of José Monzón, in appreciation of his tireless efforts during the course of our field investigations and other assistance to us in Guatemala.

Habits and habitat.—The type-locality of *Nototriton monzoni* lies some 100 km to the southwest of the type-locality of *N. wakei*, and is in a region where several isolated peaks arise out of the relatively dry lowlands. This locality is located about 2.5 km airline SSE of La Unión on slopes drained by the Río La Jigua which flows into the Río Motagua. The vegetation of the type-locality and surrounding region was classified as lower montane moist forest (Holdridge, 1959), although distinctly cloud forest conditions prevail along the crest where *N. monzoni* was obtained. No meteorological data are available for this locality, but it probably is subject to a somewhat more prolonged dry season than the type-locality of *N. brodiei* and *N. wakei*. The broad leaf forest contains numerous sweetgums (*Liquidambar*), and most of the larger trees are heavily laden with epiphytes. The type of *N. monzoni* was taken from within an axil of a bromeliad about 3 m above the forest floor.

Other species of amphibians that we collected near the type-locality of *N. monzoni* were *Bolitoglossa dofleini*, *B. mexicana*, *B. rufescens*, *Bolitoglossa* species, *Eleutherodactylus* species, *Smilisca baudinii*, and a fringe-limbed hyliid.

DISCUSSION

The members of the *Nototriton nasalis* group inhabiting Guatemala and Honduras seem to be divisible into two general morphotypes, and both of these morphotypes are represented among the new species described in this paper. Several species of *Nototriton* have small nares (NL/SL ≤ 0.012), narrow heads (HW/SL ≤ 0.12), relatively elongate bodies (costal folds between adpressed limbs ≥ 4.0 in males, ≥ 4.5 in females) with short limbs (CLL/SL ≤ 0.34), and small hands and feet (HFW/SL ≤ 0.06). Many of these traits are convergent with those found in salamanders of the genus *Oedipina* and seem to be adaptations to a semifossorial lifestyle beneath humus and leaf-litter or in tunnels in rotting logs made by beetle larvae. Included in this terrestrial group are *N. lignicola* and *N. brodiei*. The type-series of *N. lignicola* was taken from inside rotten logs (McCranie and Wilson, 1997) and all individuals of *N. brodiei* were taken on or near the ground at elevations (875–1140 m) where arboreal bromeliads are not abundant. *Nototriton barbouri* is intermediate, having somewhat larger nares and foot size than *N. lignicola* and *N. brodiei*. It may be more of a habitat generalist and has been found inside of rotten logs (McCranie and Wilson, 1997) and in the axils of arboreal bromeliads (Schmidt, 1936).

Another group of *Nototriton*, including *N. monzoni*, *N. wakei*, *N. sanctibarbarus*, *N. nasalis*, and *N. veraepacis*, is char-

acterized by larger nares (NL/SL ≥ 0.015), wider heads (HW/SL ≥ 0.13), relatively stouter bodies (costal folds between adpressed limbs ≤ 1.5 in males, ≤ 3.5 in females) with relatively long limbs (CLL/SL ≥ 0.42), and larger hands and feet (HFW/SL ≥ 0.07). Most of these features seem to be adaptations to climbing. Almost all references to the habitat of these species make reference to arboreal bromeliads: *N. monzoni* (this paper), *N. nasalis* (Meyer and Wilson, 1971), *N. sanctibarbarus* (McCranie and Wilson, 1996), and *N. veraepacis* (Lynch and Wake, 1978; pers. obs., JAC). The type of *N. wakei* was taken at an elevation (1150 m) where epiphytic bromeliads are not abundant. However, at only slightly higher elevations on the same hillside (1200 m), bromeliads become abundant and *N. wakei* probably occurs at higher elevations than currently known. The type was found on a palm leaf about 70 cm above the ground and it is possible that this species takes refuge beneath damp moss mats growing on certain trees in this forest.

It is becoming increasingly clear that many of the Middle American montane species adapted to mesic forests have been separated for periods of sufficient time allowing for speciation of many sister-populations, even those in closely adjacent mountain ranges or those restricted to the higher peaks within a single range.

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